


FUNCTIONAL DESCRIPTION

PID01

Closed Loop Controller

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1 General

PID01 is a functional unit for closed loop process control in Control^{IT}, to be operated from Operate^{IT}, Operator Station. A PID01 normally performs a complete function independently.

PID01 has the following functions and properties:

- P-, PI-, PD- and PID-algorithm.
- Control parameters can be set from the operator station or by control logic.
- Different control modes, set by operator or by control logic.
- Controllable rate of change of setpoints and output signals.
- Limiting of setpoints and output signals.
- Function for bumpless change between different control modes.
- Alarm and event handling of important control signals.

2 Configuration

PID01 comprises a function block type for control and logic functions in Control^{IT}, a faceplate and an object display in Operate^{IT} for operator functions and control parameters.

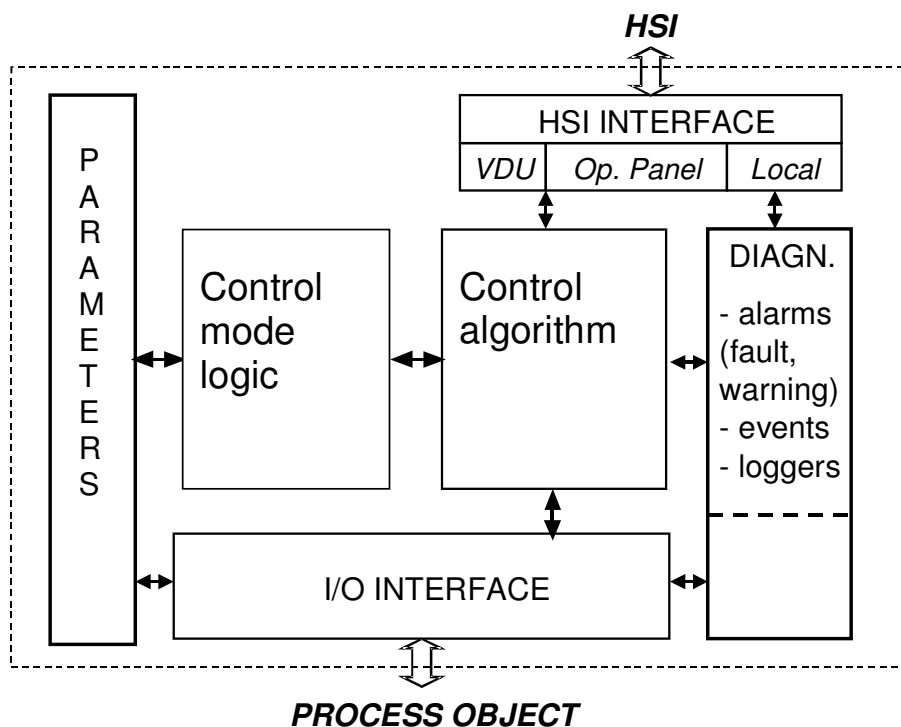


Figure 1. The Structure of the Functional Unit

3 Function Block PID01

FUNCTION OF INPUT TERMINALS	PID01		FUNCTION OF OUTPUT TERMINALS
Object name	Name	AutoSP	Auto setpoint
Object description	Description	WSP	Working setpoint
Enable object	Enable	Dev	Deviation
Selection of tracking reference	TrackA	OutP	Output
Selection of how to track	TrackB	Bal	Balance mode
Selection of tracking reference for external setpoint	TrackC	Man	Man mode
Reverse control action	RevAct	ManFd	Man Forced mode
Selection of derivation	Deriv	Auto	Auto mode
Added output value for feedforward	HotInit	E1	E1 mode
Measured Value	FeedFwd	E2	E2 mode
MV status	MV	E3	E3 mode
Max setpoint change rate in Auto mode (unit/s)	AIErr	BalOut	Balance Out
Max output change rate (unit/s)	Speed1	OutEqLL	Output less than or equal to Low Limit
Enable Man mode	Speed4	OutEqHL	Output greater than or equal to High Limit
Enable Auto mode	ManEnbl	SpEqLL	SP less than or equal to Low Limit
Enable E1 mode	AutoEnbl	SpEqHL	SP greater than or equal to High Limit
Enable E2 mode	E1Enbl	MV_GT_H2	MV greater than or equal to High High Limit (H2)
Enable E3 mode	E2Enbl	MV_GT_H1	MV greater than or equal to High Limit (H1)
External reference setpoint in E1 mode	E3Enbl	MV_LT_L1	MV less than or equal to Low Limit (L1)
External reference setpoint in E2 mode	ExtRef1	MV_LT_L2	MV less than or equal to Low Low Limit (L2)
External reference setpoint in E3 mode	ExtRef2	Dev_GT_H	Deviation greater than or equal to High Limit
Max setpoint change rate in E1 mode (unit/s)	ExtRef3	Dev_LT_L	Deviation less than or equal to Low Limit
Max setpoint change rate in E2 mode (unit/s)	Speed2	OLimErr	Output Low Limit is greater than Output High Limit
Order mode to E1	Speed3	NoInt	No Interlocks
Order mode to E2	SeqE1	Err	Error
Order mode to E3	SeqE2	ExtParOut	Control data for supervisory control
Order mode to Local	SeqE3	OutPar	Out Parameter
Order mode to Balance	Local	Opr	Operator order
Order mode to Man	BalIn		
Order mode to Auto	SeqMan		
Balance Reference	SeqAuto		
Order mode to Clamp	BalRef		
Clamp Reference	Clamp		
Enable external output limit	ClampRef		
External Output Low Limit	EOLim		
External Output High Limit	EOLL		
Process Interlock 1	EOHL		
Process Interlock 2	IB1		
Process Interlock 3	IB2		
Process Interlock 4	IB3		
Reference for Process Interlock 1	IB4		
Reference for Process Interlock 2	IB1Ref		
Reference for Process Interlock 3	IB2Ref		
Reference for Process Interlock 4	IB3Ref		
Actuator position	IB4Ref		
Block alarm	ActPos		
Acknowledge alarm	AlcBlk		
External reset feedback	AlarmAck		

Enable external reset feedback	ExtResetFB			
External control	ExtResetFBEn			
MV alarm configuration	ExtCtrl			
Deviation alarm configuration	MVAlarms			
In Parameter	DevAlarms			
Event name	InPar			

Figure 3-1. Function Block Type, Complete symbol

Table 3-1 below illustrates the default properties of each terminal of the PID01 function block.

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
Name	string	coldretain	in	yes	'PID01'	Object name
Description	string	coldretain	in	yes	'Descr'	Object description
Enable	bool	coldretain	in	yes	true	Enable object
TrackA	dint	coldretain	in	yes	1	Selection of tracking reference
TrackB	dint	coldretain	in	yes	1	Selection of how to track
TrackC	dint	coldretain	in	yes	0	Selection of tracking reference for external setpoint
RevAct	dint	coldretain	in	yes	1	Reverse control action
Deriv	dint	coldretain	in	yes	0	Selection of derivation
FeedFwd	real	retain	in	yes		Added output value for feedforward
MV	real	retain	in	yes		Measured Value
AIErr	dword	retain	in	yes	16#C0	MV status
Speed1	real	coldretain	in	yes	2.0	Max setpoint change rate in Auto mode (unit/s)
Speed4	real	coldretain	in	yes	20.0	Max output change rate (unit/s)
ManEnbl	bool	coldretain	in	yes	true	Enable Man mode
AutoEnbl	bool	coldretain	in	yes	true	Enable Auto mode
E1Enbl	bool	coldretain	in	yes		Enable E1 mode
E2Enbl	bool	coldretain	in	yes		Enable E2 mode
E3Enbl	bool	coldretain	in	yes		Enable E3 mode
ExtRef1	real	retain	in	yes		External reference setpoint in E1 mode
ExtRef2	real	retain	in	yes		External reference setpoint in E2 mode
ExtRef3	real	retain	in	yes		External reference setpoint in E3 mode
Speed2	real	coldretain	in	yes	2.0	Max setpoint change rate in E1 mode (unit/s)
Speed3	real	coldretain	in	yes	2.0	Max setpoint change rate in E2 mode (unit/s)
SeqE1	bool	retain	in	yes		Order mode to E1
SeqE2	bool	retain	in	yes		Order mode to E2
SeqE3	bool	retain	in	yes		Order mode to E3
Local	bool	retain	in	yes		Order mode to Local
Balln	bool	retain	in	yes		Order mode to Balance
SeqMan	bool	retain	in	yes		Order mode to Man
SeqAuto	bool	retain	in	yes		Order mode to Auto
BalRef	real	coldretain	in	yes	0.0	Balance Reference
Clamp	bool	retain	in	yes		Order mode to Clamp
ClampRef	real	coldretain	in	yes	0.0	Clamp Reference
EOLim	bool	retain	in	yes		Enable external output limit
EOLL	real	coldretain	in	yes	0.0	External Output Low Limit
EOHL	real	coldretain	in	yes	100.0	External Output High Limit
IB1	bool	retain	in	yes	true	Process Interlock 1
IB2	bool	retain	in	yes	true	Process Interlock 2
IB3	bool	retain	in	yes	true	Process Interlock 3
IB4	bool	retain	in	yes	true	Process Interlock 4
IB1Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 1
IB2Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 2
IB3Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 3
IB4Ref	real	coldretain	in	yes	0.0	Reference for Process Interlock 4

Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
ActPos	real	retain	in	yes		Actuator position
AlcBlk	bool	retain	in	yes		Block alarm
AlarmAck	bool	retain	in	yes		Acknowledge alarm
ExtResetFB	real	retain	in	yes		External reset feedback
ExtResetFBEn	bool	retain	in	yes		Enable external reset feedback
ExtCtrl	Ext_Control	by_ref	in	yes		External control
MVAAlarms	Alarm4Limit	by_ref	in	yes		MV alarm configuration
DevAlarms	Alarm2Limit	by_ref	in	yes		Deviation alarm configuration
InPar	PID01_InPar	by_ref	in	yes		In Parameter
EventName	string	coldretain	in	yes	' PID01_'	Event name
AutoSP	real	retain	out	yes		Auto setpoint
WSP	real	retain	out	yes		Working setpoint
Dev	real	retain	out	yes		Deviation
OutP	real	retain	out	yes		Output
Bal	bool	retain	out	yes		Balance mode
Man	bool	retain	out	yes		Man mode
ManFd	bool	retain	out	yes		Man Forced mode
Auto	bool	retain	out	yes		Auto mode
E1	bool	retain	out	yes		E1 mode
E2	bool	retain	out	yes		E2 mode
E3	bool	retain	out	yes		E3 mode
BalOut	bool	retain	out	yes		Balance Out
OutEqLL	bool	retain	out	yes		Output less than or equal to Low Limit
OutEqHL	bool	retain	out	yes		Output greater than or equal to High Limit
SpEqLL	bool	retain	out	yes		SP less than or equal to Low Limit
SpEqHL	bool	retain	out	yes		SP greater than or equal to High Limit
MV_GT_H2	bool	retain	out	yes		MV greater than or equal to High High Limit (H2)
MV_GT_H1	bool	retain	out	yes		MV greater than or equal to High Limit (H1)
MV_LT_L1	bool	retain	out	yes		MV less than or equal to Low Limit (L1)
MV_LT_L2	bool	retain	out	yes		MV less than or equal to Low Low Limit (L2)
Dev_GT_H	bool	retain	out	yes		Deviation greater than or equal to High Limit
Dev_LT_L	bool	retain	out	yes		Deviation less than or equal to Low Limit
OLimErr	bool	retain	out	yes		Output Low Limit is greater than Output High Limit
NoInt	bool	retain	out	yes		No Interlocks
Err	bool	retain	out	yes		Error
ExtParOut	Ctrl_Data	by_ref	out	yes		Control data for supervisory control
OutPar	PID01_OutPar	by_ref	out	yes		Out Parameter
Opr	PID01_Opr	by_ref	out	yes		Operator order

Table 3-1. Terminal properties.

4 PID01 Datatypes

4.1 PID01_InPar

Name	Data Type	Attributes	Initial value	ISP value	Description
Class	dint	coldretain	500		AE class
Severity	dint	coldretain	1000		AE severity
MVRange	RangeReal	coldretain			MV Range
OUTRange	RangeReal	coldretain			OUT Range
SPLimit	RangeLimit	coldretain			SP limit
OUTLimit	RangeLimit	coldretain			OUT limit
InitMode	dint	coldretain	5		Init mode (5 = Man ; 6 = Auto ; 7 = E1 ; 8 = E2 ; 9 = E3)
ManFdBlk	bool	coldretain	false		Block operator order Man Forced mode
SeqManEvBlk	bool	coldretain	true		Block event for SeqMan
SeqAutoEvBlk	bool	coldretain	true		Block event for SeqAuto
SeqE1EvBlk	bool	coldretain	true		Block event for SeqE1
SeqE2EvBlk	bool	coldretain	true		Block event for SeqE2
SeqE3EvBlk	bool	coldretain	true		Block event for SeqE3
AlcBlkEvBlk	bool	coldretain	true		Block event for AlcBlk
EOLimEvBlk	bool	coldretain	true		Block event for EOLim
LocalEvBlk	bool	coldretain	true		Block event for Local
BallnEvBlk	bool	coldretain	true		Block event for Balln
ClampEvBlk	bool	coldretain	true		Block event for Clamp
IB1	IBInParType3	coldretain			Configuration for IB1
IB2	IBInParType3	coldretain			Configuration for IB2
IB3	IBInParType3	coldretain			Configuration for IB3
IB4	IBInParType3	coldretain			Configuration for IB4
ErrCtrl	bool	coldretain			No error at overflow
AEConfigAIErr	dint	coldretain	1		AE configuration for AI Error
AlarmDelay	time	coldretain	0s		Alarm Delay
ShowActPos	bool	coldretain	false		Show actuator position
IntBlk	bool	coldretain	false		Block integral action
DerBlk	bool	coldretain	true		Block derivative action
OUTIncDec	real	coldretain	2.0		Increase/Decrease step of output (In percentage of range)
SPIncDec	real	coldretain	1.0		Increase/Decrease step of setpoint (In percentage of range)
Gain	real	coldretain	0.5		Gain
TI	real	coldretain	15		Integration Time
TD	real	coldretain	0.0		Derivative Time
TF	real	coldretain	0.0		Filter Time
Beta	real	coldretain	1.0		Beta Factor
TIDeadB	real	coldretain	0.0		Integration Deadband

4.2 PID01_OutPar

Name	Data Type	Attributes	Initial value	ISP value	Description
AlarmBlk	bool	retain			Alarm blocked
IntlkBlk	bool	retain			Interlock blocked
IntlkBlkActive	bool	retain			Interlock blocked active
EnOverrideAll	bool	retain			Override All button enabled
Mode	dint	retain			Active mode
NormalMode	bool	retain			Normal mode (Active mode = Init mode)
AIErr	bool	retain			MV error
Forced	bool	retain			MV forced
IB1Ind	bool	retain			IB1 interlocked
IB2Ind	bool	retain			IB2 interlocked
IB3Ind	bool	retain			IB3 interlocked

Name	Data Type	Attributes	Initial value	ISP value	Description
IB4Ind	bool	retain			IB4 interlocked
MVH2	real	retain			Active High High MV alarm limit
MVH1	real	retain			Active High MV alarm limit
MVL1	real	retain			Active Low MV alarm limit
MVL2	real	retain			Active Low Low MV alarm limit
DevH	real	retain			Active High Deviation alarm limit
DevL	real	retain			Active Low Deviation alarm limit
ALB_H2	bool	retain			High High MV alarm blocked
ALB_H1	bool	retain			High MV alarm blocked
ALB_L1	bool	retain			Low MV alarm blocked
ALB_L2	bool	retain			Low Low MV alarm blocked
ALB_DevH	bool	retain			High Deviation alarm blocked
ALB_DevL	bool	retain			Low Deviation alarm blocked
AU_MVH2	bool	retain			UnAcknowledge alarm for MV > H2
AU_MVH1	bool	retain			UnAcknowledge alarm for MV > H1
AU_MVL1	bool	retain			UnAcknowledge alarm for MV < L1
AU_MVL2	bool	retain			UnAcknowledge alarm for MV < L2
AU_DevH	bool	retain			UnAcknowledge alarm for Dev > H
AU_DevL	bool	retain			UnAcknowledge alarm for Dev < L
AU_AIErr	bool	retain			UnAcknowledge alarm for AI Error
Direction	bool	retain			Direction (0 = direct ; 1 = reverse)
HWStatus	HwStatus	retain			Hardware status
SubStatus	dint	retain			Hardware substatus
IOStatus	dint	retain			Hardware I/O status quality

4.3 PID01_Opr

Name	Data Type	Attributes	Initial value	ISP value	Description
BlockAlarm	bool	retain			Operator block alarms
ALB_H2	bool	retain			Operator block alarm limit H2
ALB_H1	bool	retain			Operator block alarm limit H1
ALB_L1	bool	retain			Operator block alarm limit L1
ALB_L2	bool	retain			Operator block alarm limit L2
ALB_DevH	bool	retain			Operator block alarm deviation H
ALB_DevL	bool	retain			Operator block alarm deviation L
ManFd	bool	retain			Operator order Manual Forced mode
Man	bool	retain			Operator order Manual mode
Auto	bool	retain			Operator order Auto mode
E1	bool	retain			Operator order E1 mode
E2	bool	retain			Operator order E2 mode
E3	bool	retain			Operator order E3 mode
Incr	real	retain			Operator order Increase SP command
Decr	real	retain			Operator order Decrease SP command
OverrideAll	bool	retain			Operator override all interlocks
IB1Override	bool	retain			Operator override IB1 interlock
IB2Override	bool	retain			Operator override IB2 interlock
IB3Override	bool	retain			Operator override IB3 interlock
IB4Override	bool	retain			Operator override IB4 interlock
AutoSP	real	coldretain	0.0		Operator enter Auto Setpoint
ManOUT	real	coldretain	0.0		Operator enter Man OUT

5 Function

5.1 Basic Properties

The PID01 functional unit is designed for regulatory control in different processes.

PID01 normally performs all control functions independently, however there are situations where PID01's functionality needs to be supplemented. Such cases can include

- Ratio Control, where a Ratio Station RATIO01 supplements the PID01.
- Increase/Decrease control, where a three state controller CON-PU1 supplements the PID01.
- For special control applications additional logic can be used to supplement PID01.

PID01 has the following basic functions.

- P, PI, PD or PID control algorithm.
- External control parameters, which can be useful when applying i.e., gain scheduling.
- External control data, which can be useful for supervisory control.
- Feed Forward
- Control modes: BAL, Man, Auto and different cascade alternatives.
- Logic for allocation of priority in the selection of control mode.
- Different versions of setpoint tracking.
- Rate of change limiting of the different setpoints and of the output signal.
- The possibility to limit setpoints and output signals.
- Functions for bumpless transfers between the different control modes.
- Possibility to Forced the control of the output signal.
- Alarm and event handling.

5.2 Control Algorithm


The algorithm consists of a controller with optional P-, PI-, PD- or PID-characteristics. The different parameters can be set from the operator station or by control logic.

Derivation can be performed on measured value or deviation.

Direct or reversed control action is selectable.

5.2.1 Control Deviation

Control deviation is the difference between the working setpoint and the measured value from the process. This is processed in accordance with the control parameters given to

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the P-, PI-, PD- or PID- algorithms. The result of this processing is applied to the output signal.

Calculation of Control Deviation

The control deviation is calculated with the following equation:

$$DEV = MV - WSP$$

DEV = control deviation

MV = measured value (Internally limited to the range of the signal)

WSP = working setpoint

5.2.2 Transfer Function

The transfer function for a PID controller consists of the sum of the different transfer functions for PI-controller and derivator.

$$G(s) = Gain \left(\beta * WSP - MV + \frac{1}{s \cdot T1} + \frac{s \cdot TD}{1 + s \cdot TF} \right)$$

GAIN = gain constant * (OutMax – OutMin) / (MVMax – MVMin)

TI = integration time constant

TD = derivation time constant

β = setpoint factor

TF = filter time constant.

The PID algorithm in the software performs the following tests:

- If $\frac{TS}{TI} > 1$, then $\frac{TS}{TI}$ is set = 1
- $Abs(Dev) > IntegralDeadband$, otherwise no integration change.
- TD and TF $\geq 2 \times TS$, otherwise TD and TF are set = 2 x TS

TS = the sampling time for the controller.

The setpoint factor appearing in the P part makes the formula differ from the most common form of a PID controller (in which case this factor has the fixed value = 1, the P part thus operating on the deviation DEV). The inclusion of β (=BETA) allows the loop to be made faster without causing big overshoots at setpoint changes. To get an ordinary P or PD controller without a reducing setpoint factor, you have to choose BETA = 1.

The factor BETA allows two-degree-of-freedom control in the PID controller. This means that the response to a setpoint step of a certain size differs from a disturbance step in the measured value of the same size. Using a value of BETA less than one can be used to avoid excessive overshoot in the setpoint step response (controller is slower for setpoint changes compared to measurement disturbances). But this factor can also be used to increase the setpoint gain (thereby speeding up the setpoint step response) in cases where the controller proportional gain has to be kept low due to a high disturbance level (i.e. measurement noise).

5.2.3 External control parameters

With the input "ExtCtrl" the control and alarm parameters can be externally controlled, which can be useful when applying i.e., gain scheduling. The input is a structured data type with the following components, which can be individually utilized.

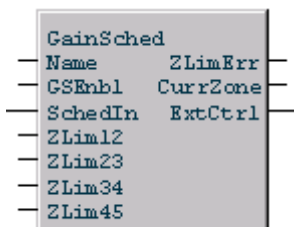
Index No.	Name	Data Type	Attributes	Initial Value	Description
1	GainEnbl	bool	retain	FALSE	External Gain Enable
2	Gain	real	retain	0.5	External Gain
3	TIEenbl	bool	retain	FALSE	External IntegrationTime Enable
4	TI	real	retain	30	External Integration Time
5	TDEnbl	bool	retain	FALSE	External DerivationTime Enable
6	TD	real	retain	0	External DerivationTime
7	TFEenbl	bool	retain	FALSE	External Filter Time Enable
8	TF	real	retain	0	External Filter Time
9	IntBlkEnbl	bool	retain	FALSE	External Integration Block Enable
10	IntBlk	bool	retain	FALSE	External Integration Block
11	DerBlkEnbl	bool	retain	FALSE	External Derivation Block Enable
12	DerBlk	bool	retain	FALSE	External Derivation Block
13	SPLimEnbl	bool	retain	FALSE	External Setpoint Limit Enable
14	SPH	real	retain	100	External Setpoint High Limit
15	SPL	real	retain	0	External Setpoint Low Limit
16	En_H2	bool	retain		Enable HH Limit
17	MVH2	real	retain	100	High Limit 2
18	ALB_H2	bool	retain		Blocking of alarm limit H2
19	En_H1	bool	retain		Enable H Limit
20	MVH1	real	retain	100	High Limit 1
21	ALB_H1	bool	retain		Blocking of alarm limit H1
22	En_L1	bool	retain		Enable L Limit
23	MVL1	real	retain	0	Low Limit 1
24	ALB_L1	bool	retain		Blocking of alarm limit L1
25	En_L2	bool	retain		Enable LL Limit
26	MVL2	real	retain	0	Low Limit 2
27	ALB_L2	bool	retain		Blocking of alarm limit L2
28	En_DevH	bool	retain		Enable Dev High Limit
29	DevH	real	retain	100	Deviation High Limit
30	ALB_DevH	bool	retain		Blocking of alarm Dev High limit
31	En_DevL	bool	retain		Enable Dev Low Limit
32	DevL	real	retain	-100	Deviation Low Limit
33	ALB_DevL	bool	retain		Blocking of alarm Dev Low limit
34	SetpStationModeEnbl	bool	retain	FALSE	Enable QCS Setpoint Station Mode
35	Bal	bool	retain	FALSE	Balance Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
36	Man	bool	retain	FALSE	Manual Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
37	Auto	bool	retain	FALSE	Auto Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
38	E1	bool	retain	FALSE	E1 Mode (Used when SetpStationModeEnbl is True and PID Enable is False)
39	AI_Error_Override	bool	retain	FALSE	Bypass AI Error check (used when SetpStationModeEnbl is True)

Index No.	Name	Data Type	Attributes	Initial Value	Description
40	On_Off_Ctrl_Enbl	bool	retain	FALSE	Enable On Off Ctrl
41	On_Off_Ctrl	bool	retain	FALSE	On Off Ctrl
42	ManOut_Enbl	bool	retain	false	External Entered Output Enable
43	ManOut	real	retain		External Entered Output
44	SP_Enbl	bool	retain	false	External Entered Setpoint Enable
45	SP	real	retain		External Entered Setpoint
46	WSP_Enbl	bool	retain	false	External Working Setpoint Enable
47	WSP	real	retain		External Working Setpoint

Table 4-1. ExtCtrl Terminal properties of PID01

5.2.4 Gain scheduling

Gain scheduling can be accomplished by connecting the output “ExtCtrl” of the element “GainSched” to the input “ExtCtrl” of the PID01. If GSEnbl is not active the Zone 1 values will be used.



Name	Data Type	Attributes	Direction	FD Port	Initial value	Description
Name	string	coldretain	in	yes	'GainSched'	Object name
GSEnbl	bool	coldretain	in	yes	false	Enable gain scheduling
SchedIn	real	coldretain	in	yes	0.0	Scheduling Input
ZLim12	real	coldretain	in	yes	20.0	Zone 1 to 2 Limit
ZLim23	real	coldretain	in	yes	40.0	Zone 2 to 3 Limit
ZLim34	real	coldretain	in	yes	60.0	Zone 3 to 4 Limit
ZLim45	real	coldretain	in	yes	80.0	Zone 4 to 5 Limit
ZLimErr	bool	retain	out	yes		Zone limit error
CurrZone	dint	retain	out	yes		Current zone
ExtCtrl	Ext_Control	by_ref	out	yes		External control

5.2.5 External control data

With the output “ExtParOut” internal data from the control can be used by e.g. supervisory control. The output is a structured data type with the following components, which can be individually utilized.

Index No.	Name	Data Type	Attributes	Initial Value	Description
1	Name	string	retain	'Pid01'	Object Tag Name
2	Description	string	retain	'Descr'	Object Description
3	MV	real	retain		Measured Value
4	WSP	real	retain		Working Setpoint
5	OutP	real	retain		Output signal
6	ActPos	real	retain		Actuator Position
7	Max	real	retain		Max Range, MV
8	Min	real	retain		Min Range, MV

Index No.	Name	Data Type	Attributes	Initial Value	Description
9	SPH	real	retain		Setpoint High Limit
10	SPL	real	retain		Setpoint Low Limit
11	OHL	real	retain		Output High Limit
12	OLL	real	retain		Output Low Limit
13	Gain	real	retain		Gain
14	TI	real	retain		Integration Time
15	TD	real	retain		Derivative Time
16	DeadZ	real	retain		Deadzone
17	RevAct	dint	retain		Reverse Control Action
18	NoInt	bool	retain		No Interlock
19	SpEqLL	bool	retain		Setpoint equal to low limit
20	SpEqHL	bool	retain		Setpoint equal to high limit
21	OutEqLL	bool	retain		Output equal to low limit
22	OutEqHL	bool	retain		Output equal to high limit
23	Mode	dint	retain		Control Mode, -1=Bal, 0=Man, 1=Auto, 2=E1, 3=E2, 4=E3, 5=ManFd
24	TopMode	dint	retain		Highest Control Mode, 0=Man, 1=Auto, 2=E1, 3=E2

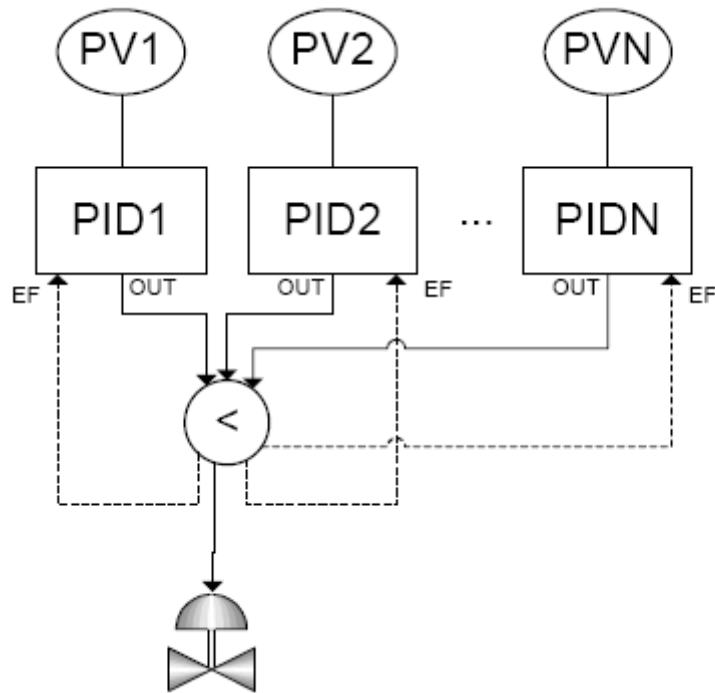
Table 4-2. ExtParOut Terminal properties of PID01

5.2.6 Feed Forward

In automatic modes, the output of the controller is generated by the control algorithm, with the value of the input :FeedFwd added. The result is checked against high and low limits and rate limit, as described.

5.2.7 External Feedback

The purpose of external feedback is to set up an arrangement of 2 or more PID controllers which share a common output but have different process values and setpoints. As there's only one output which has effect over the process, some selection logic must be added to decide which PID controller acts the output. Normally this will be a minimum selector, although any other selector or more complicated logic may be used. For this logic to work the actual output must be informed to all PID controllers so that the output of the PID controllers that don't have control over the process don't saturate. This control scheme is called overrun control.



A PID's output in automatic mode may be obtained as follows,

$$OutP = G * Dev + Der + Int + FF$$

Integral term is calculated by the controller in each scan according to,

$$Int = Int + IntDiff$$

Where

$$IntDiff = Dev * G * Ts / Tint$$

External feedback functionality, which is controlled by the parameter ExtResetFBEn, is included by modifying the previous equation as follows,

$$IntDiff = (Dev * G * + ExtFBRef - OutP) * Ts / Tint$$

5.3 Control Modes

5.3.1 Control Mode Command Signals and Priority

The signals for control mode change are placed in order of priority. LOCAL has the highest priority and SEQE3 has the lowest priority. The current control mode is determined by the active inputs with the highest priority by a pulse. The inputs are of three different types; static, set-reset and dynamic.

- The static input must be activated for the corresponding control mode to be applied. If the signal at the input disappears, the control mode changes over to MAN, provided no static input with a lower priority takes over the selection of the control mode.
- Set-Reset means that the control mode is selected when the input is activated. If the input is reset to zero, the control mode remains in effect until some other input is activated. If the SR-input is kept active, only inputs with a higher priority can assume the selection of control mode.

- The dynamic input is only initiating. The control mode is selected when a change from 0 to 1 occurs at the input.

The control mode can be enabled individually. Input terminals ManEnbl, AutoEnbl, E1Enbl, E2Enbl and E3Enbl can be set in the function block with constants or by application logic. By enabling a single control mode under certain conditions it is possible to lock the control mode to prevent switching to another control mode.

Table 4-2 illustrates control mode activation and priority when selected from either an application program or from the operator station.

Commands		Mode selected					
Signal	Source	Balance	Manual	Auto	E1	E2	E3
Local ⁽¹⁾	Program						
Balln ⁽¹⁾	Program						
Clamp ⁽¹⁾	Program						
Manual Forced ⁽²⁾	Operator						
Interlocks	Program	Remains unchanged					
AI-error	AI-channel						
Man	Operator						
SeqMan ↑ ⁽³⁾	Program						
Auto	Operator						
SeqAuto ↑ ⁽³⁾	Program						
E1	Operator						
E2	Operator						
E3	Operator						
SeqE1 ↑ ⁽³⁾	Program						
SeqE2 ↑ ⁽³⁾	Program						
SeqE3 ↑ ⁽³⁾	Program						

Table 4-2. Control modes selection and priority.

- (1) On leaving mode Balance or Manual Clamped (i. e. when the command signal returns to zero), mode Manual is always obtained, unless any signal commands another mode.
- (2) The mode MAN Forced is temporarily left while a command signal with higher priority is active. The mode is not left finally, until the operator gives a command for another mode. All other commands of lower priority are blocked.
- (3) The arrow ↑ indicates that only the positive transition of the signal is relevant for commanding a mode change.

The purpose and function of each control mode is described below.

5.3.2 Balance

Balance control mode is used to force the controller output to a value present at the input terminal BalRef. The operator cannot override this mode.

When the controller is operating in Balance mode the output signal follows the balance reference signal. This mode is used when the control signal is disconnected and the controller is balanced for a bumpless return to control.

Control mode BAL is activated by:

- The activation of input terminal LOCAL. An indication of BAL LOCAL is presented on the object display and Bal on the Faceplate mode indicator.
- The activation of input terminal BALIN. An indication of BAL is presented on the object display and Bal on the Faceplate mode indicator.

Examples of use can be as follows:

- Manual emergency control, which has the highest priority. An operator, working centrally at the display screen cannot take over control from a local backup station located adjacent to the process function.
- When another function block or other logic other than the process controller is to take over the control. An example is cascade coupling of several process controllers.

5.3.3 Manual

Manual is the initial control mode of the controller. In this mode the operator directly sets the output value from the operator station. The rate of output value is limited by the value at terminal Speed4. Manual mode is enabled by input terminal ManEnabl.

The control mode MAN is activated by:

- Input terminal CLAMP gives the indication MAN CLAMP in the object display.
- Changeover to manual forced mode by using the MFd button on the operator's faceplate. Indication MAN on the object display.
- Input terminal AIERR <> 1 changes the control mode to MAN. "No error at overflow" can be selected from the interaction window
- By clicking on the Man button on the operator's faceplate. Man is indicated on the object display and Faceplate.

Examples of use:

- Manual control of an actuator under abnormal operation conditions e.g. in connection with a malfunction.
- Manual control at start and stop.

5.3.4 Manual Forced

Manual Forced is a non-regulatory control mode, like the manual mode, where the operator sets the output. This mode overrides the Interlocks.

All these control modes are selectable by the operator, if not restricted in control logic. Following control modes are selected by program logic.

The control mode MANFd is activated by:

- Changeover to manual forced mode by using the MFd button on the operator's faceplate. Indication MAN on the object display.

Examples of use:

- During a plant stop interlocks could prevent opening of the valve. ManFd enables the operator to still use the valve for ie. testing etc.

5.3.5 Auto

Auto is the automatic control mode, where the operator sets the setpoint. The rate of change of the setpoint value is limited by the value at terminal Speed1. Auto mode is enabled by input terminal AutoEnabl.

The control mode AUTO is activated by:

- By clicking on the Auto button on the operator's faceplate. Auto is indicated on the object display and Faceplate.
- Input terminal SEQAUTO when activated by a pulse.

5.3.6 E1 and E2

E1 and E2 are automatic control modes, where the setpoint is obtained from an external source. The rate of setpoint values is limited by the value at terminals Speed2 and respectively Speed3. E1 and E2 modes are enabled by input terminals E1Enabl and E2Enabl.

With control mode E1 (External 1) the setpoint consists of a signal received from an external source at input terminals ExtRef1 and ExtRef2. The control mode E1 and E2 can be commanded from the operator's keyboard, from another application logic or from an external control device.

The control mode E1 or E2 is activated by:

- By clicking on the E1 or E2 buttons on the operator's faceplate. Ext1 or Ext2 is indicated on the object display and Faceplate.
- Input terminal SEQE1 or SEQE2 when activated by a pulse.

Examples of use:

- Cascade control.
- Setpoint control from an optimizing function.
- Local setting of setpoint.

- Recipe-controlled setpoint.

5.3.7 E3

E3 is the non-regulatory control mode, where the setpoint is derived from program logic and directly applied to the output. It has the same functionality as Manual mode excepting that the setpoint to the output comes from program logic and not the operator. The output signal is forced to follow an external reference. E3 mode is enabled by input terminal E3Enabl.

The control mode E3 is activated by:

- By clicking on the E3 button on the operator's faceplate. Ext3 is indicated on the object display and Faceplate.
- Input terminal SEQE3 when activated by a pulse.

Examples of use:

- When it is desirable to control the output signal with low priority e.g. from a local operator's station or from a PC. The responsibility for the control can then always be taken over at a central operator's station.
- In connection with traditionally named DDC (Direct Digital Control).

5.4 Interlocks

The controller can be interlocked by using IB1 and IB2 input terminals. Deactivation of these terminals set the output value to a fixed value, which is present at the IB1Ref and IB2Ref input terminals. These interlocks do not change the current control mode, but can be overridden by Manual Forced, when selected by the operator. If the control mode is "Manual" when the interlock is released, the output will stay at the "interlock-value".

- IB1 has higher priority than IB2.
- Both have higher priority than EOLim.
- EOLim, however, can not be overridden by Manual Forced.

5.5 Start-up

An initialisation phase begins at start of the AC800M system. Manual is the default control mode at system initialisation or after a download. It is possible to force the control mode to other modes at system initialisation.

The input terminal HOTINIT: controls the selection of the control mode and output with respect to the status, which was present before the initialization.

- 0 Control mode and output unchanged.
- 1 Control mode changed to Manual, output unchanged.
- 2 Control mode changed to Manual, output = 0 or = OLL

5.6 Process connections

The PID01 is connected to the process via the following two input terminals.

- MV Connection for measured value e.g. a level transmitter.
- OUP Control output to e.g. a control valve.

5.7 Reverse Action

The following control functions are activated when the REVACT: input terminal is enabled with the values as shown below.

- 0 Direct action in "PI" and "D" sections. (INC/INC)
- 1 Reverse action in "PI" and "D" sections. (INC/DEC)
- 2 Direct action in "PI" section. Reverse action in "D" section.
- 3 Reverse action in "PI" section. Direct action in "D" section.

5.8 Ramp Functions

Ramp functions are introduced into the signal paths to determine the maximum permitted rate of change of certain signals. These are designated RAMP and are located in the function block and used for CONTROL DEVIATION, SETPOINT SELECTION and FORCED CONTROL. The maximum permitted rate of change is determined by the operational parameter SPEED (X) and is specified in process-related variables/second or percentage units/second, depending on the signal.

5.9 Setpoint Selection, Mode transitions and Tracking

The term "working setpoint" is the setpoint that the controller uses in its algorithm in all modes. The "auto setpoint" is the setpoint that the operator enters in auto mode. In auto mode the auto setpoint is transferred to the working setpoint.

SETPOINT SELECTION contains the following functions:

- Selection of external reference (1 or 2)
- Tracking
- Ramp functions
- Limitations

5.9.1 Selection of External Reference

The working setpoint is external reference 1(E1) in control mode Ext1 or external reference 2(E2) in control mode Ext2.

5.9.2 Tracking

The tracking functions are intended to eliminate abrupt changes of the setpoint on return to the different control modes. Tracking functions are available for both auto and external modes and are activated during mode transfers.

During a mode transfer the working setpoint will ramp to selected setpoint if TrackA (Auto SP Track Reference) and TrackC (External SP Track Reference) are enabled.

The auto setpoint can be set to follow the process value and/or the external setpoints by means of TrackB (SP Track Selection).

5.9.2.1 Tracking of AUTO setpoint

Two tracking functions are included for the AUTO setpoint (AUTOSP). The tracking functions can be activated with other control modes than AUTO. Their purpose is to permit bumpless connection of the AUTO setpoint or connection with constant signal value.

The function is selected with two parameters, TRACKA and TRACKB.

- TRACK A: Selection of tracking reference.
 - 0 No tracking.
 - 1 Tracking on "MV" if TRACK B not = 0.
 - 2 Tracking on "External setpoint" if TRACK B not = 0.
- TRACK B: Selection of how to track.
 - 0 No tracking.
 - 1 Working setpoint tracks signal according to TRACK A.
 - 2 Working setpoint and Auto setpoint tracks signal according to TRACK A.

TrackA	TrackB	Description
0	0	No tracking.
X	0	No tracking.
1	1	AutoSp is not affected. The working setpoint, WSP, is tracking the measured value, MV, when not in Auto mode. The WSP is ramped to equal AutoSp with a speed that is determined by Speed1.
2	1	AutoSp is not affected. The working setpoint, WSP, is tracking the value of ExtRef1 or ExtRef2, depending on whether operating mode E1 or E2 applies. The WSP is ramped to equal AutoSp with a speed that is determined by Speed1. "Tracking" takes place in the operating modes E1 and E2.
1	2	AutoSp and Working setpoint tracks the measured value, MV when not in Auto mode. Changeover to Auto takes place both without bumps and changes
2	2	AutoSp and Working setpoint tracks the external setpoint ExtRef1 or ExtRef2, depending on whether operating mode E1 or E2 applies. Changeover to Auto takes place both without bumps and changes. Tracking takes place in the operating modes E1 and E2.

Table 4-3. Selection for tracking function of AutoSp.

5.9.2.2 Tracking of External setpoints

The tracking functions are intended to eliminate abrupt changes of the setpoint on return to the control modes E1 and E2 respectively. The tracking functions are controlled with a function parameter TRACKC.

Two tracking functions below are integrated in Track C.

- External reference 1 can follow the measured value or the working setpoint with a control mode other than E1.
- External reference 2 can follow the measured value or the the working setpoint with a control mode other than E2.

Table 4-4 below describes the changeover for each function.

TrackC	Description
0	No tracking
1	The external setpoints ExtRef1 and ExtRef2 are tracking the measured value, MV, when not in mode E1 or E2. The internal setpoint, Extref, is thereafter ramped to equal ExtRef1 or ExtRef2 as applicable with a speed that is determined by Speed2 or Speed3 respectively. ExtRef1 is tracking in all control modes but E1, while ExtRef2 is tracking in the all modes but E2.
2	The external setpoints ExtRef1 and ExtRef2 are tracking the working setpoint, WSP, when not in mode E1 or E2. The internal setpoint, Extref, is thereafter ramped to equal ExtRef1 or ExtRef2 as applicable with a speed that is determined by Speed2 or Speed3 respectively. ExtRef1 is tracking in all control modes but E1, while ExtRef2 is tracking in the all modes but E2.

Table 4-4. Selection of tracking function for ExtRef.

5.9.3 Setpoint Ramp Functions

The input terminals described below determine the maximum permitted rate of change as follows:

- Speed 1 Auto setpoint speed. Specified in engineering units/second.
- Speed 2 Ext1 setpoint speed. Specified in engineering units/second.
- Speed 3 Ext2 setpoint speed Specified in engineering units/second.

5.9.4 Setpoint Limitations

The limiting values SPH and SPL apply for both AUTO setpoint and the external references E1 and E2. The setpoint limits are set in the Extended Faceplate on the faceplate element "Limits2".

5.10 Forced Control

Forced control may also be initiated to a reference value i.e. on receiving an incorrect signal from an analog input (AI), the output signal for example ramps down to zero.

The function block contains the following functions:

- Selection of control signal
- Tracking
- Ramp functions
- Limitations

5.10.1 Selection of Control Signal

There are three forms to force the control of the output signal:

- Manual is selected with the control mode MAN
- External references are selected with the control mode E3
- Clamping is selected with the clamping function (control mode MAN)

The following inputs are be used for forced control.

Speed4 Highest permitted rate of change of the output signal.

Clamp Command signal for clamping. The mode changes to MAN. When the Clamp signal is released the mode will still be MAN.

ClampRef Clamping reference value when terminal Clamp is activated.

ExtRef3 External reference value for the output signal in mode E3

5.10.2 Tracking

Tracking functions are integrated to eliminate abrupt output signal changes at change-over to and from the control modes MAN, Clamp (MAN) and E3.

5.10.3 Output Ramp Functions

The input terminals described below determine the maximum permitted rate of change as follows:

- Speed 4 Output ramp speed. Specified in percent units/second.

5.10.4 Output Limitations

The limiting values Out H and Out L limit the value of the output signal. The output limits are set in the Extended Faceplate on the faceplate element "Limits1".

5.11 Output Signal Control

Output signal control includes the following functions.

- Selection of output signal
- Output signal limitation

5.11.1 Selection of Output Signal

The output signal is selected in accordance with the control mode as follows:

- AUTO, E1, E2 output control signal
- MAN, Clamp (MAN), E3 output control signal
- BAL control signal, the value of balance reference is transferred to the output.

The following input terminals are being used for output control.

FEEDFWD	Feed Forward
BALREF	Balance reference
EOHL	Upper external limiting value
EOLL	Lower external limiting value
EOLIM	Signal for selection of external limitation
OUTP	Output signal
OLIMERR	Crossed external limiting value

5.11.2 Output Limiting

The controller output signal is normally limited to Max and Min values of the Real IO signal, connected to the output but limiting values on this signal can be determined either from the operator's station or externally.

The limiting upper and lower values Out H and Out L limit the value of the output signal. The output limits are set in the Extended Faceplate on the faceplate element "Limits1".

The activation of input terminal EOLIM determines whether the external limits EOLL and EOHL or internal limits Out H and Out L are applied to the output limitation. The operator-entered limiting values are not affected when external limits are used. The limiting values currently active are presented on the faceplate and object display.

The limiting values from the operator Out H and Out L can be set equal but Out L cannot be set greater than Out H. If the external limiting value EOLL is greater than EOHL then only the upper value EOHL applies. The output signal can thereby be force controlled to the value for EOHL. The crossing of the limiting values causes a fault indication (OLIMERR).

5.12 Scaling and Units

The process controller works internally with process-related units up to the calculation of the control deviation where there is a changeover to percentage units. This means that measured values and setpoints, both internal and external are specified in process-related units and other signals in percentage units.

The deviation is expressed in percent of the measured value range (MAX-MIN). The PI-block and the D and output signal have a default range of -100% to +100%. Scaling is possible. The output signal (OUTP) scaling is possible except in the Operator Station bargraph which shows 0 - 100%.

5.13 Alarm and Alarm Limitation Functions

The following alarms are monitored in the function block:

- Measured value MV with two upper and two lower alarm limits
- Control deviation DEV with one upper and one lower alarm limit

When an alarm limit is exceeded, an alarm, which must be acknowledged, is transmitted to the operator station (and printer, if provided). Alarms are also available as outputs on the Function Block.

The time stamping of the alarm is done when the function block is executed.

5.13.1 Alarm Limits

When determining the MV alarm limits, the following equation applies:

$$H 2 \geq H 1 \geq L 1 \geq L 2$$

If an attempt is made to cross the alarm limits with each other, the operator is notified that the operation is not permitted. There is no change of the limit.

5.13.2 Alarm Blocking

Supervision of the measured value (MV) and control deviation (DEV) is blocked by activating the input connection ALCBLK.

Automatic alarm blocking can be suitable in connection with start and stop and with anticipated events, the so-called sequential fault blocking. The signal outputs are also affected by this blocking (as to differentiate from operator's blockings which are only blocked on the operator's station and printer).

The event handling function makes it possible to block all alarms from the operator's station or from the function block.

The following errors can be blocked:

$$MV \geq H 2$$

$$MV \geq H 1$$

$$MV \leq L 1$$

$$MV \leq L 2$$

$$DEV \geq H 1$$

$$DEV \leq L 1$$

Using Event handling to block alarms means that the printer and operator's station and updating of the error list are blocked. The PC outputs are not affected.

The following terminals are used for alarm handling.

ALCBLK	Blocking of alarm on MV and DEV
MV_GT_H2	Measured value exceeds H2
MV_GT_H1	Measured value exceeds H1
MV_LT_L1	Measured value less than L1
MV_LT_L2	Measured value less than L2
DEV_GT_H	Deviation exceeds H1
DEV_LT_L	Deviation less than L1
SP=HL	Setpoint limit, high
SP=LL	Setpoint limit, low
OUT=HL	Output signal limit, high
OUT=LL	Output signal limit low

5.13.3 Event Handling

Event are generated for status change on the signals defined in interaction window in chapter 5.14.9.

All Operator Events are reported by Audit Trail Functionality and not included in the FunctionBlock.

The individual text string for each event is stored in the Alarm and Event Translator aspect. This text can be NLS handled.

5.14 Interaction Window

The interaction window is available in the Control^{IT} Control Builder. The interaction window is an engineering aid used to simplify configuration and blocking of signals not available on the faceplates. Changes to values in the Interaction window are only available in 'Online' mode in Control^{IT}.

5.14.1 Pid01 Interaction Window

Interaction window overview. Name and description are shown. The buttons are links to sub-windows.

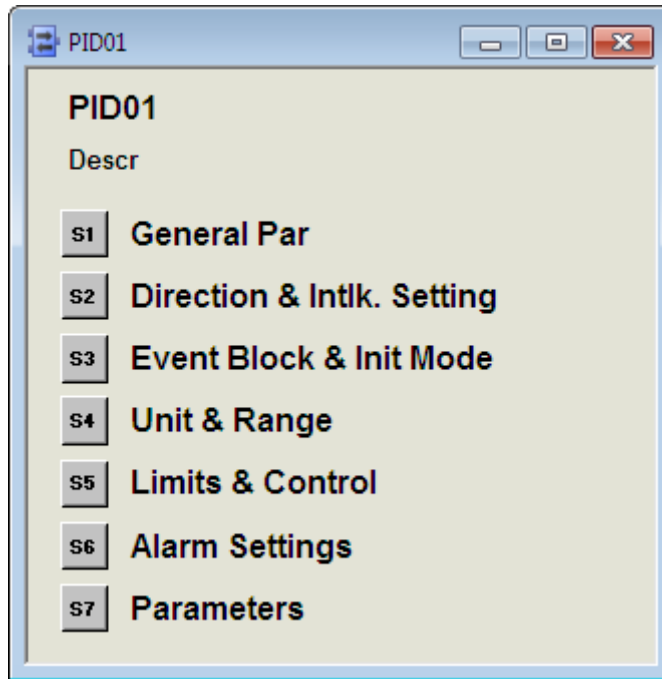


Figure 4-1 Main Interaction Window.

5.14.2 General Parameters

“Class” defines the process section or area in which alarms are grouped. By utilizing class the alarms can be filtered. Valid values are user defined. A suggestion would be to use mill area numbers as class values.

“Severity” defines the alarm priority for general alarms. The severity for MV-alarms is entered in window “Alarm & Event”. Valid values are 1 –1000 where 1000 is the highest priority.

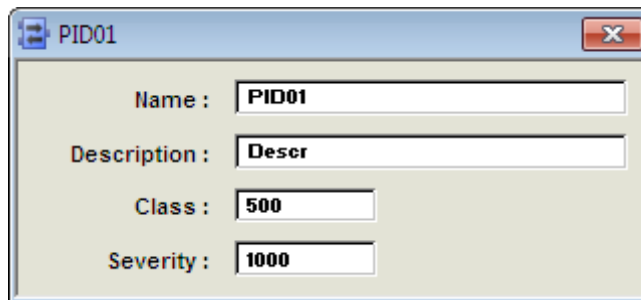


Figure 4-2 General Parameters.

5.14.3 Direction & Intl. Blockings

Control Action (Incr/Incr, Incr/Decr) – indication of direct or reverse control action.

MV Direction (Incr/Decr) – indication of MV response to operator increasing to output.

Actuator Direction (Op/Cls) – indication of actuator response to operator increasing the output.

On/Off Control – indication of actuator feedback in Faceplate and Object Display.

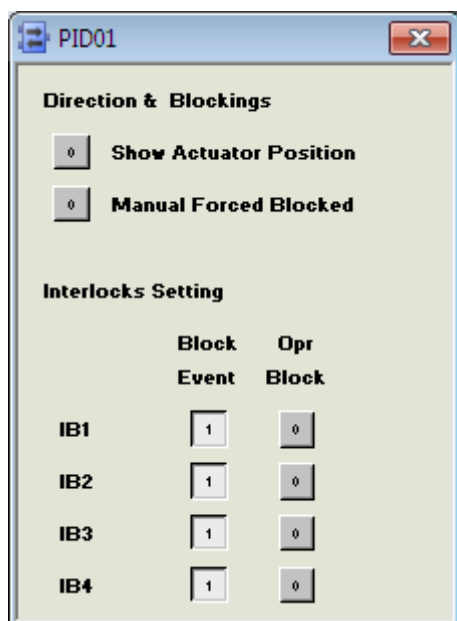


Figure 4-3 Direction & Intl. Blockings.

5.14.4 Units and Range

Measured Value and output (PO), minimum, maximum, units and decimals are entered in this interaction window. The step change for operator increase/decrease buttons is also set in this window.

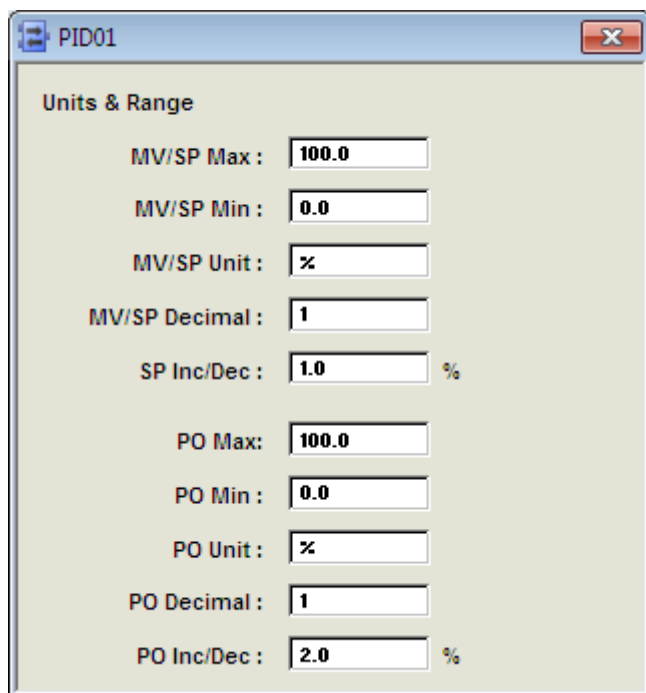


Figure 4-4 Units & Range.

5.14.5 Limits & Control

Limits for output signal and possibility to set output and/or setpoint.

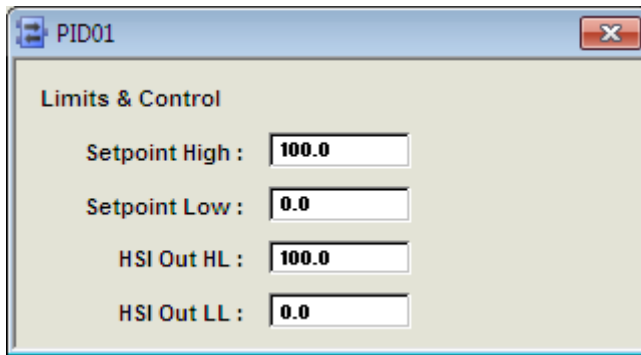


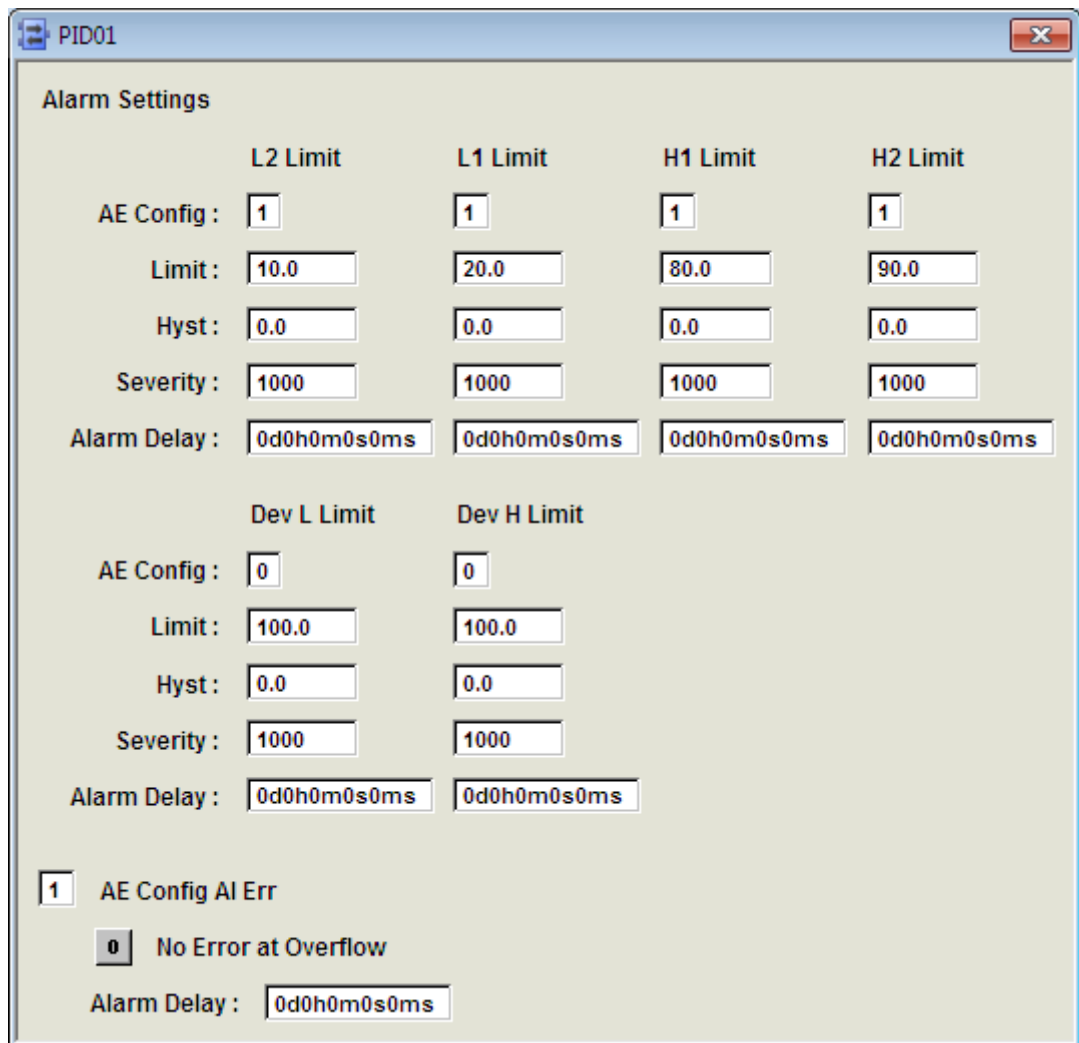
Figure 4-5 Limits & Control.

5.14.6 Alarm & Event handling

Alarm limits, Severity and Enabling of the alarms for measured value and deviation as well as hysteresis and alarm delay time is entered in this window.

For AE config the following values are valid

- 0 No Alarm or Event are generated
- 1 Alarm and Event are generated
- 2 Event is generated



5.14.7 Text

The different interlock and information texts are entered in the aspect Text Properties. The length of the text is limited to about 60 characters, by the size of presentation element in the Interlock Display.

Name	Value	Type	Description	Readable?	R/Permission	Writable?	W/Permission	Deploy Scheme
IB1Text		String	IB1 Interlock Text	Yes		Yes	Configure	Always Repla
IB2Text		String	IB2 Interlock Text	Yes		Yes	Configure	Always Repla
IB3Text		String	IB3 Interlock Text	Yes		Yes	Configure	Always Repla
IB4Text		String	IB4 Interlock Text	Yes		Yes	Configure	Always Repla
BalName		String	Bal Name	Yes		Yes	Configure	Always Repla
ClampName		String	Clamp Name	Yes		Yes	Configure	Always Repla
E1Name		String	E1 Name	Yes		Yes	Configure	Always Repla
E2Name		String	E2 Name	Yes		Yes	Configure	Always Repla
E3Name		String	E3 Name	Yes		Yes	Configure	Always Repla
EOLimName		String	EOLim Name	Yes		Yes	Configure	Always Repla
Info1Text		String	Info 1 Text	Yes		Yes	Configure	Always Repla
Info2Text		String	Info 2 Text	Yes		Yes	Configure	Always Repla

Figure 4-7 Texts.

5.14.8 Parameters

In this window the control parameters are shown and adjusted, unless external control of the parameters are selected.

Parameters

Gain :

TI :

TD :

TF :

Beta :

TI Deadb :

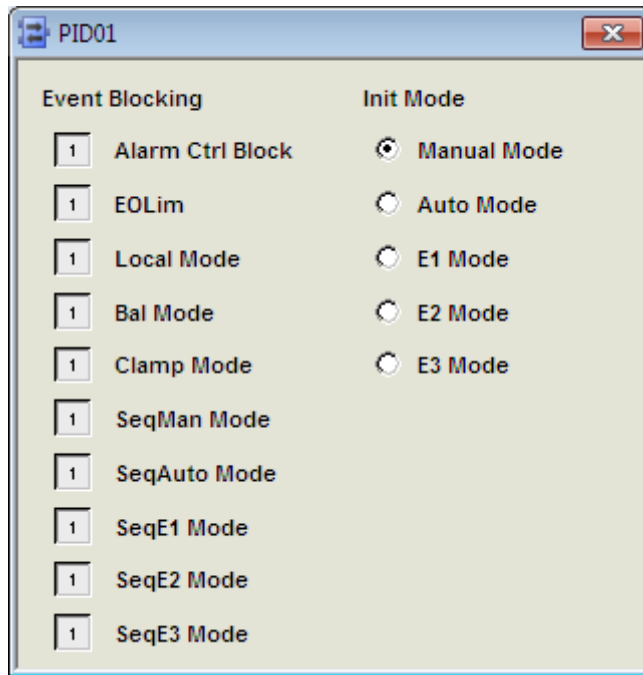
Int Block :

Der Block :

Figure 4-8 Parameters.

5.14.9 Event Handling

The blocking of Events are entered in this Interaction Window



5.14.10 Gain Scheduling

In this window the control parameters for the different zones are entered.

The screenshot shows a software window titled "GainSched" with a standard Windows-style title bar (minimize, maximize, close buttons). The window contains a configuration interface for gain scheduling, organized into five distinct zones. Each zone is represented by a set of input fields for Gain, TI, TD, TF, and a Limit value. The values are as follows:

Zone	Gain	TI	TD	TF	Limit
Zone 1	0.5	30.0	0.0	0.0	20.0
Zone 2	0.0	30.0	0.0	0.0	40.0
Zone 3	0.0	30.0	0.0	0.0	60.0
Zone 4	0.0	30.0	0.0	0.0	80.0
Zone 5	0.0	30.0	0.0	0.0	

Figure 4-10 Gain Scheduling.

6 Operator Functions

The Operator functions are divided in principle into 4 parts:

- Presentation (Display elements, Time logged properties)
- Faceplate (Dialog)
- Alarm and Event handling
- Text handling

6.1 Presentation

6.1.1 Display Elements

Display elements, which can be used for different display types, are available for use in the functional unit PID01.

The display elements show the status and the controls of the process with different degrees of detail and are intended for the following displays:

- Object display
- Process display
- Interlock display

Examples of different display elements which could be used are given in the following sections.

6.1.1.1 Object Display

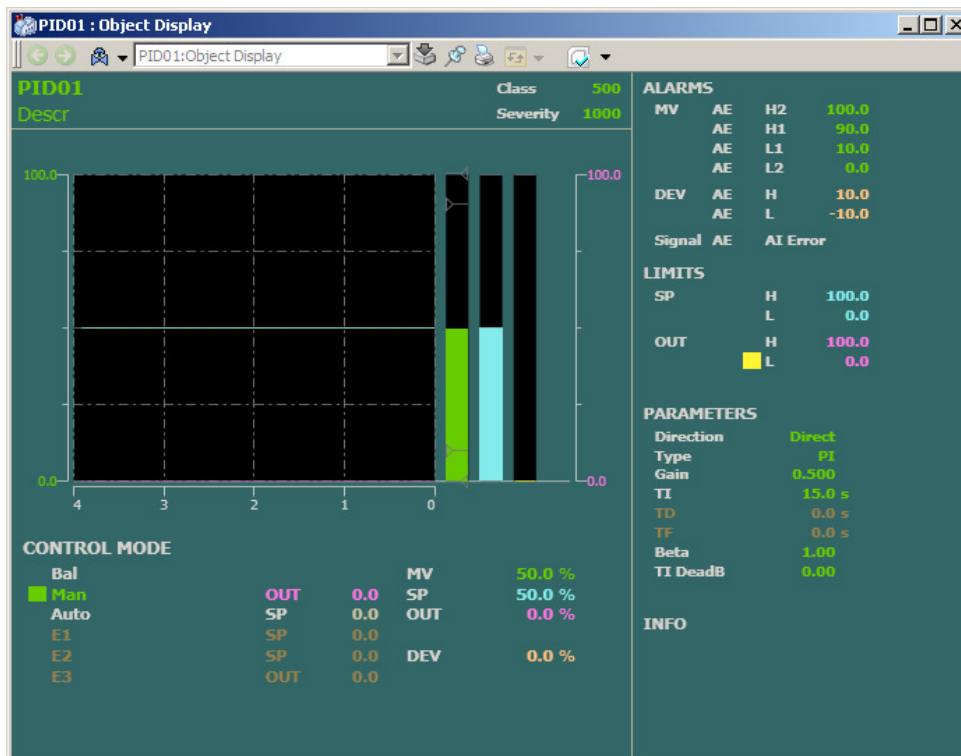


Figure 5-1 Object Display.

6.1.1.2 Process Display

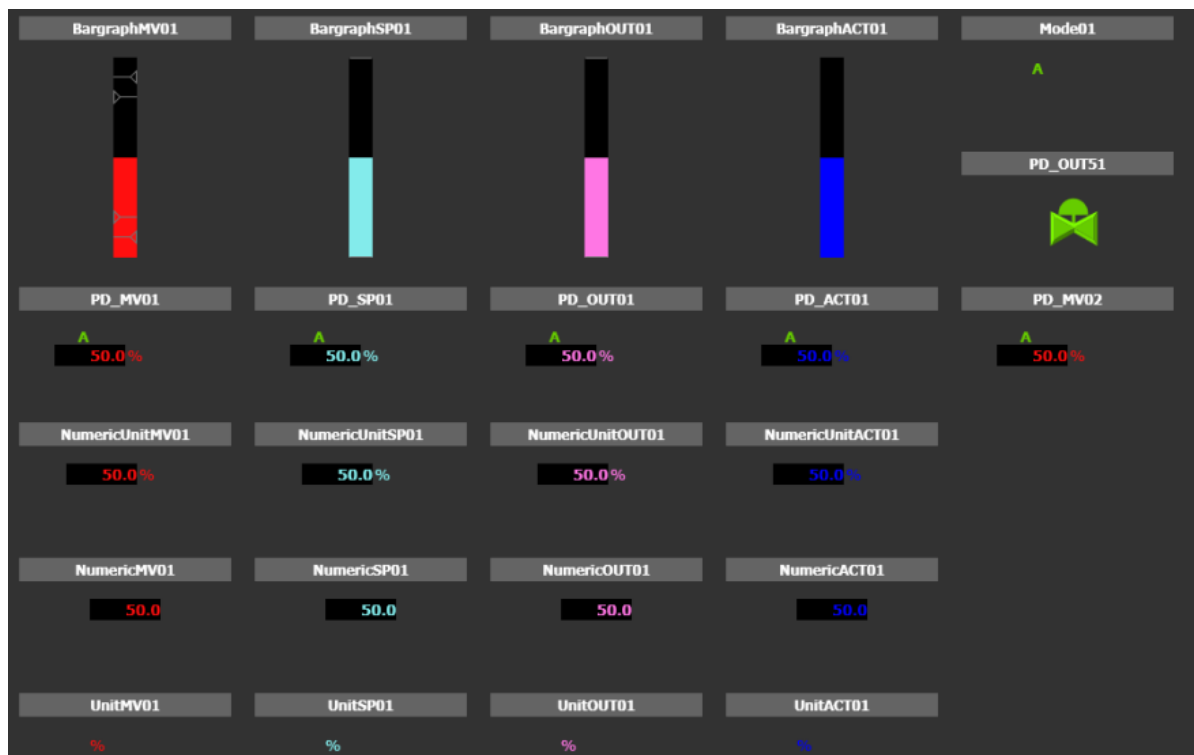


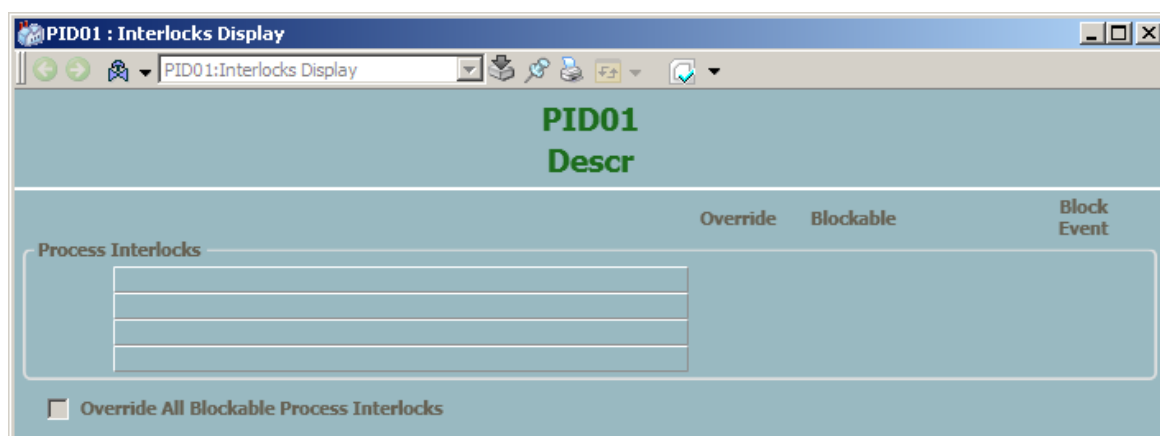
Figure 5-2 Process Display Elements.

6.1.1.3 Interlock Display

This display shows the actual status of all Interlock. The operator can override individual interlocks or all interlock.

Interlocks that can be overridden must be set to Blockable. This can be done from this display if the user has permission Configure or from the Interaction Window see chapter 5.14.3.

Start Interlock, Block Event and IA Blocked when no in E1 or E2 mode are parameters that can be set from this display if the user has Permission Configure or from Interaction Window.



6.1.2 Time-logged Properties

Measured values stored can be presented graphically in the form of curves on the display screen. Such a display, a **Trend display**, can consist of 1- 4 curves. All properties for the object PID01 are available to be logged on the trend curves.

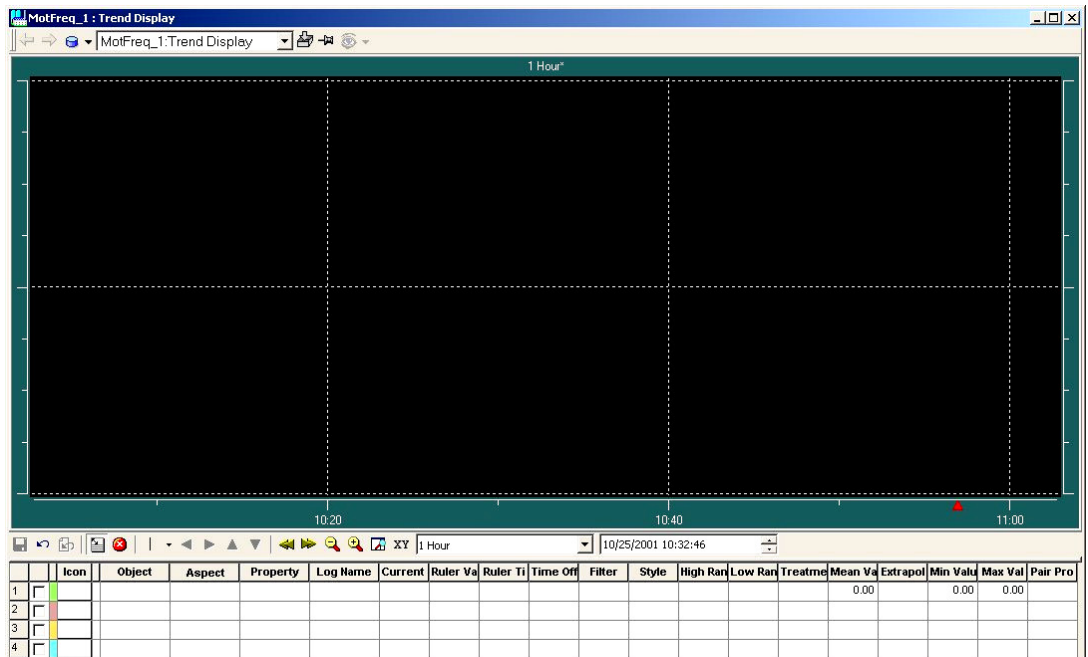


Figure 5-3 Trend Curve

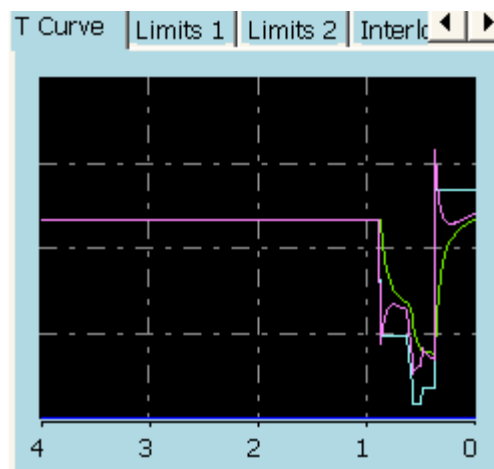


Figure 5-4 Extended Faceplate (T Curve)

6.2 Faceplate(Dialog)

The display screen is supplemented with a mouse and keyboard for operator communication with the functional unit/object.

By using Operate^{IT} Operator Station the operator can view and control the process through faceplates. The dialogue consists of buttons, indicators and graphic presentations within a Faceplate. A faceplate has three levels of dialogue, which are presented by the following three runtime views:

- Reduced Faceplate, where the size and contents typically have been optimized to cover most of the normal process operator actions. Minimum dialogue. This is the default view.
- Faceplate, which typically covers all normal process operator actions. This view is disabled as default.
- Extended Faceplate, with functions and information intended for the process engineer or the advanced operator. Maximum dialogue.

The figures 5-5 to 5-7 below and overleaf illustrate the various presentations of the faceplate.

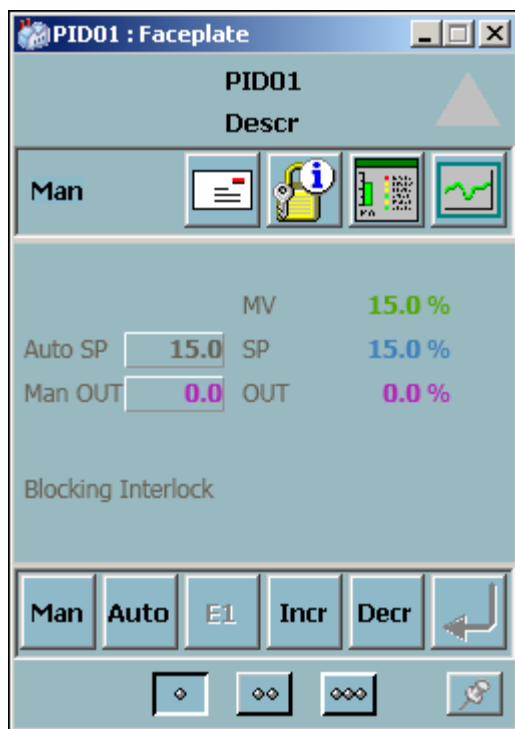


Figure 5-5 Reduced Faceplate.

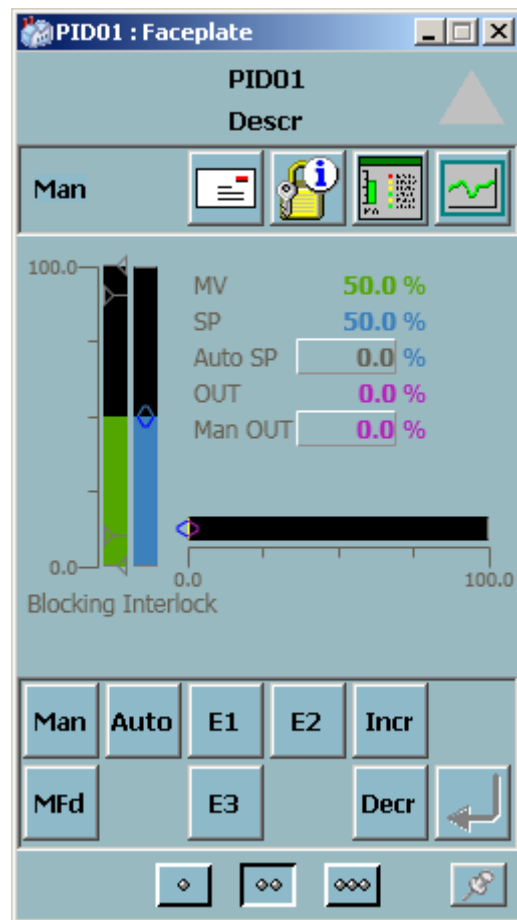


Figure 5-6 Faceplate.

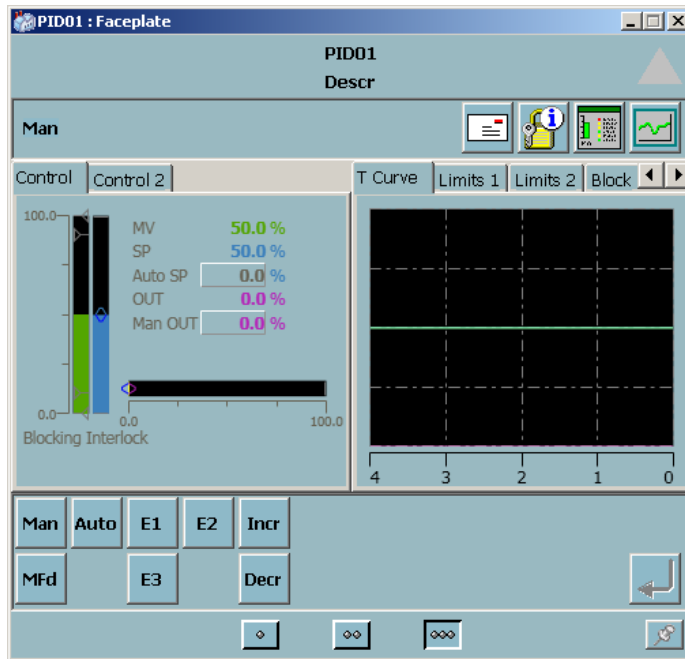


Figure 5-7 Extended Faceplate

6.3 Alarm and Event Handling

6.3.1 General

This section contains a description of all alarms and events in the functional unit PID01.

When a measured value deviates from the controllers limits or fails an alarm and an event is generated and can be viewed on the Operate^{IT} Operator Station. The alarms are indicated in the faceplate, object display and in the alarm and event list.

The possibilities of the operator to block alarms are shown under the heading 'Event and alarm blocking' below.

The alarm limits for PID01 can be controlled individually

Event Time	Object Name	Object Description	Condition	Message Description
02-05-24 03:46:16:763	264M500.RUN	Pulp Mixer Running	Status	Alarm
02-05-24 01:13:04:785	192.168.0.51-0.11.5		HWError	For info see 'Errors and
02-05-24 00:22:18:784	192.168.0.51-0.11.4		HWError	For info see 'Errors and
02-05-23 23:32:31:458	500F1920	Washing Pulp Flow	AI_Err	Alarm
02-05-23 23:32:31:458	500F1920	Washing Pulp Flow	MV_L1	Alarm
02-05-23 23:32:31:458	500F1920	Washing Pulp Flow	MV_L2	Alarm
02-05-23 23:23:01:784	192.168.0.51-0.11.3		HWError	For info see 'Errors and
02-05-23 20:00:07:762	500F1920	Washing Pulp Flow	MV_L2	Alarm
02-05-23 01:38:52:762	500F1920	Washing Pulp Flow	MV_L1	Alarm
02-05-23 00:18:26:995	500F1920	Washing Pulp Flow	AI_Err	Alarm
02-05-22 00:10:00:709	Mot01	Test Mot01	ControlV	Alarm
02-05-20 17:32:45:784	192.168.0.51-0.11.2		HWError	For info see 'Errors and

Figure 5-8 Alarm List

6.3.2 Alarm and Event Message

The following alarm texts are generated by the functional unit PID01. The "Message Description" is "hard coded" in the function block and can not be modified.

The “Condition” text are stored in the Alarm and Event Translator aspect and can be NLS handled.

Object Name	Object Description	Condition	Message Description
<Name>	<Description>	AIError	Alarm
<Name>	<Description>	DevHigh	Alarm
<Name>	<Description>	DevLow	Alarm
<Name>	<Description>	MV>H1	Alarm
<Name>	<Description>	MV>H2	Alarm
<Name>	<Description>	MV<L1	Alarm
<Name>	<Description>	MV<L2	Alarm

The following event texts are generated. The “Message Description” text are stored in the Alarm and Event Translator aspect and can be NLS handled.

SourceName	ObjectDescription	Condition	Message Description
<Name>	<Description>		SeqE1 Mode
<Name>	<Description>		SeqE2 Mode
<Name>	<Description>		SeqE3 Mode
<Name>	<Description>		SeqAuto Mode
<Name>	<Description>		SeqMan Mode
<Name>	<Description>		Bal Mode
<Name>	<Description>		Clamp Mode
<Name>	<Description>		Local Mode
<Name>	<Description>		EoLim On
<Name>	<Description>		EoLim Off
<Name>	<Description>		IB1 On
<Name>	<Description>		IB1 Off
<Name>	<Description>		IB2 On
<Name>	<Description>		IB2 Off
<Name>	<Description>		Alarm Acknowledge
<Name>	<Description>		Alarm P Blk

6.4 Faceplate tabs

6.4.1 Alarm and Event Blocking

By using the extended faceplate it is possible for the process engineer to block alarms.

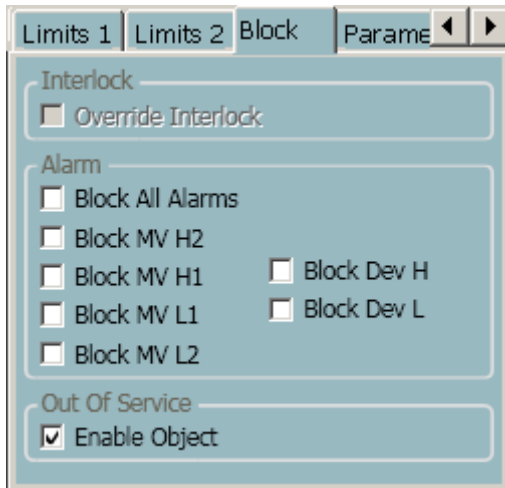


Figure 5-9 Extended Faceplate (Block1)

6.4.2 Limits

By using the extended faceplate it is possible to adjust the limits for the measured value, the setpoint, the deviation and the output. The faceplate elements in the extended faceplate below illustrate this.

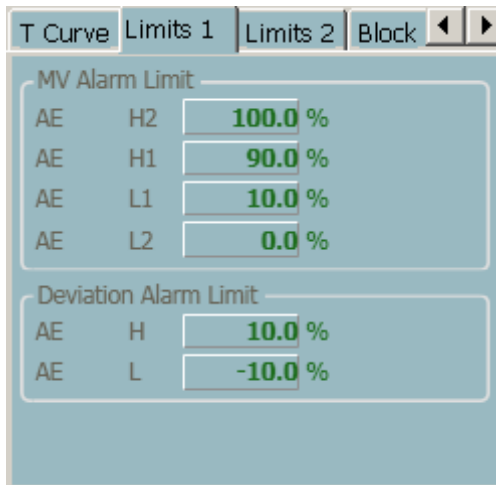


Figure 5-11 Extended Faceplate (Limits1)

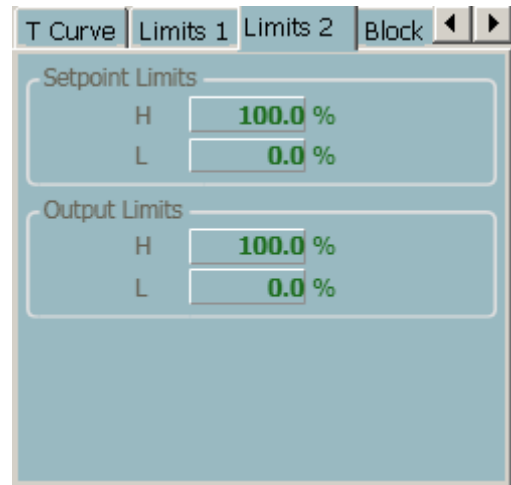


Figure 5-12 Extended Faceplate (Limits2)

6.4.3 Controller Parameters

The “Param” faceplate element in the extended faceplate below illustrates where it is possible to adjust the gain, integral time, derivation time and filter time for the controller. The scan time, control action and controller type is also indicated here.

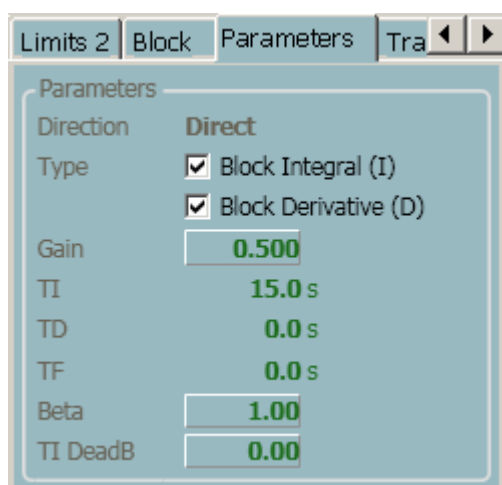


Figure 5-13 Extended Faceplate (Param)

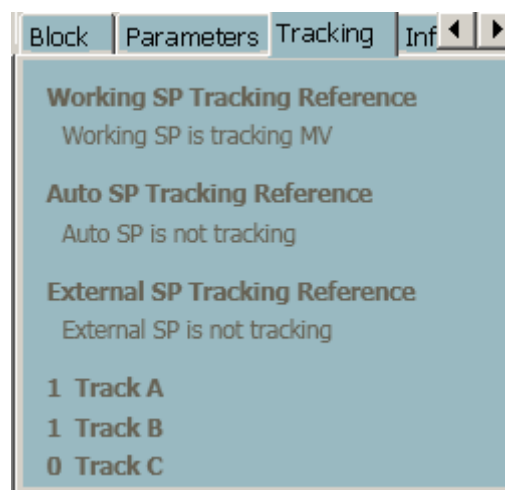
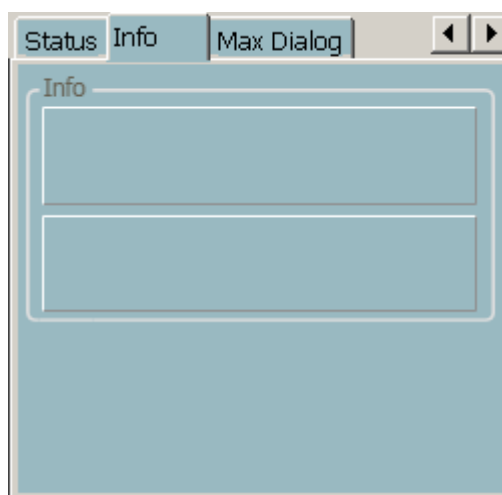


Figure 5-14 Extended Faceplate (Tracking)

6.4.4 Info Text



6.4.5 IO status

The "Status" tab is showing the type of device and it's status for the measured value.

If the signal is connected via a Profibus PA link the extended status from the device is showed in this tab. For more information see document *Integration of PA instruments 3AST001 792 D0090*

T Curve	Limits	Block	Status	◀ ▶
Status				
Device	S800 I/O			
Description	ABB			
HwState	<input checked="" type="checkbox"/>			
Change Time	See I/O Module			
Err / Warn				
Ext Status				

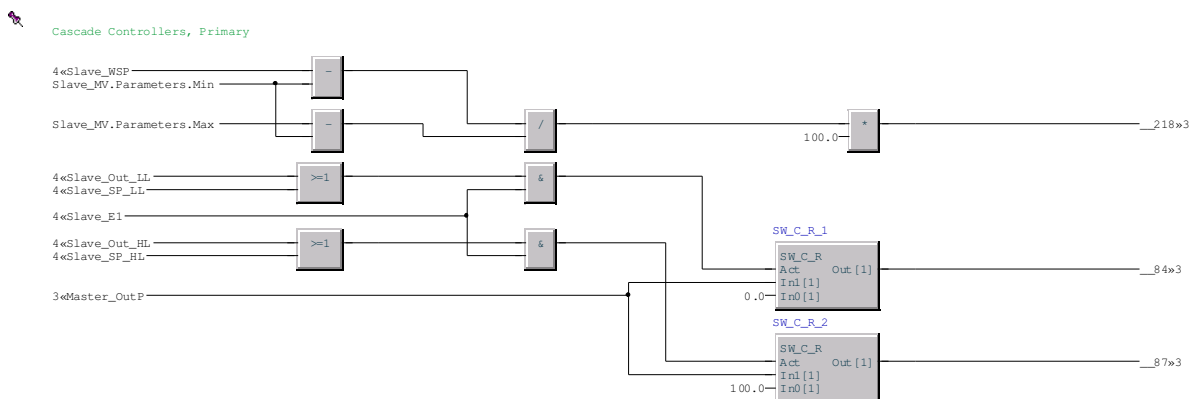
7 Appendix A

7.1 Cascade example

Below is an application example of two PID01 controllers in a cascade configuration.

	Name	Data Type	Attributes	Initial value	I/O address	Access Variables	Description
1	Master_MV	RealIO	retain				
2	Master_OutP	Real	retain				
3	Master_Oref	Real	retain				
4	Slave_MV	RealIO	retain				
5	Slave_OUT	RealIO	retain				
6	Slave_WSP	Real	retain				
7	Slave_E1	Bool	retain				
8	Slave_Out_LL	Bool	retain				
9	Slave_Out_HL	Bool	retain				
10	Slave_SP_LL	Bool	retain				
11	Slave_SP_HL	Bool	retain				
12	Slave_BalOut	Bool	retain				

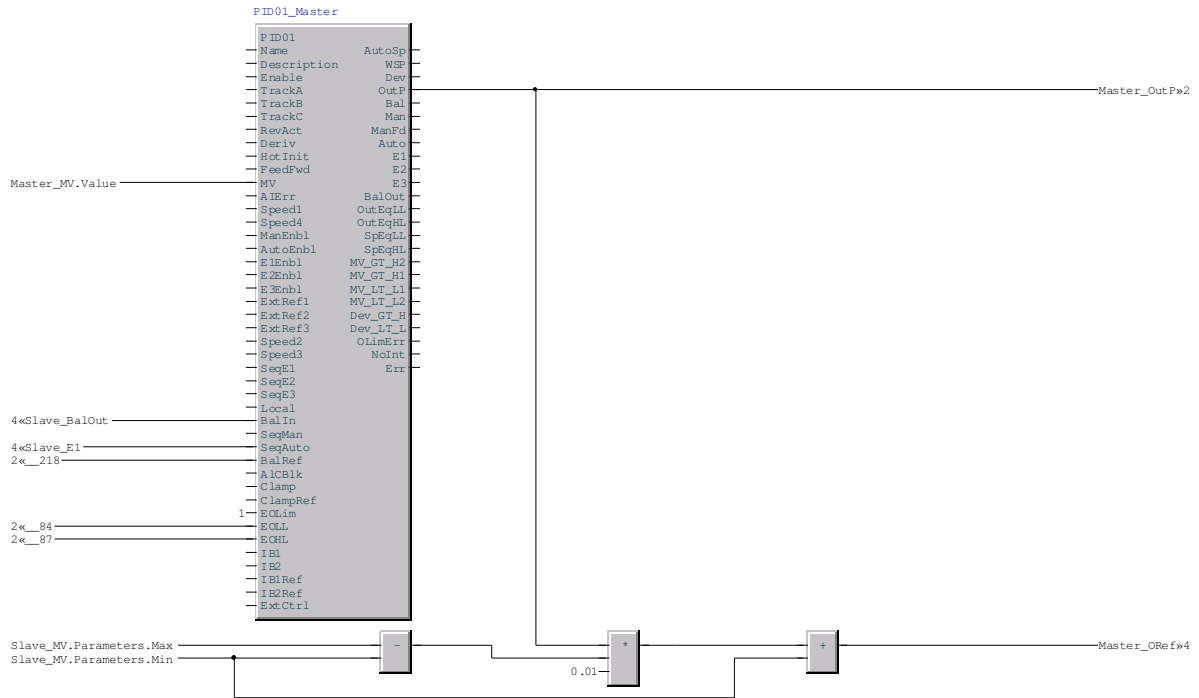
Table 1. Program - Application_1:PID_Test (Variables)



Functional Unit PID01 Functional Description



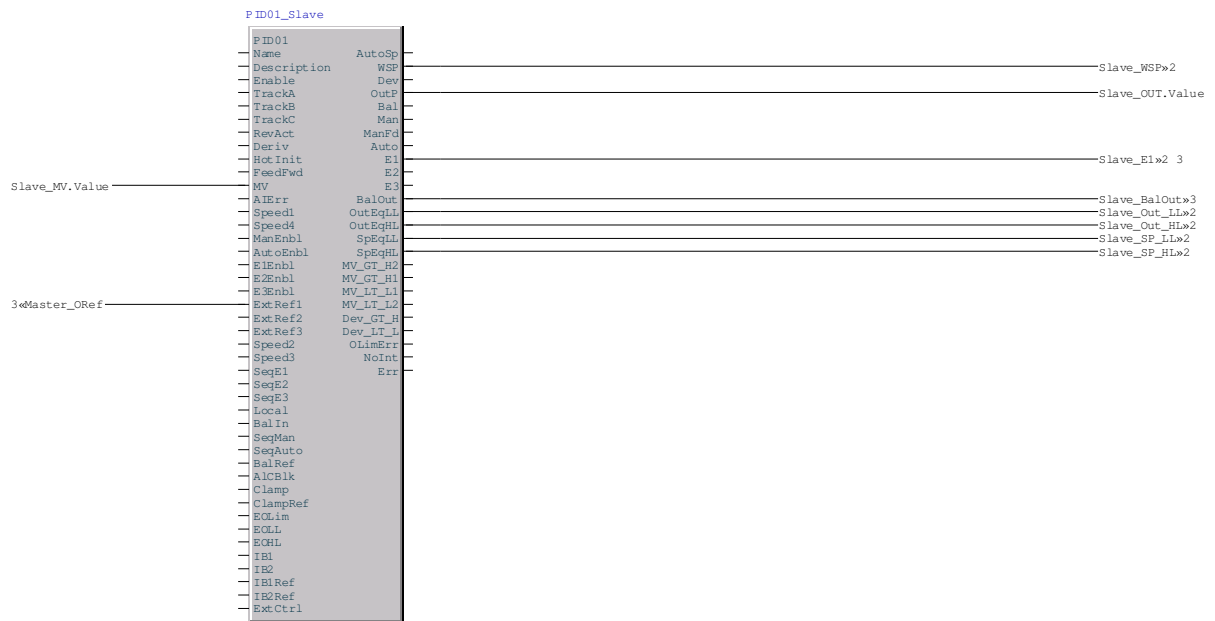
Cascade Controllers, Primary



3



Cascade Controllers, Secondary



4

REVISION

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
A		Rev 1.3	021113/MP
B		Rev 2.0	030310/MP
C		Rev 2.0/1	031024/MP
D		Rev 2.0/2	031217/MP
E	4, 5, 7	Initialization	04-04-15/FM
F	3	Rev 3.1/2	050319/MP
G	4,5	Event handling added. Interaction Window and Process Display elements updated	050401/BP
H	4, 5	Faceplate, Rev 4.0/1	050902/MP
I	4.5	Interlocks	050929/MP
J	3	Rev4.0/5	070510/BP
K	4.2	Clarification of control algorithm	071113/MP
L		Rev 5.0-1 Clarification of Beta factor, External control data updated; Interlock functionality updated, External Feedback added.	081203/BP
M		Rev 5.0-2 Update of Ext Control data, Faceplate elements and Interaction Window elements	090909/BP
N		Update Rev 5.1/0	101103/BP